Biological Results of the Strait of Georgia Spiny Dogfish (*Squalus Acanthias*) Longline Survey October 10-22, 2008

J.R. King and G.A. McFarlane

Fisheries and Oceans Canada
Science Branch, Pacific Region
Pacific Biological Station
Nanaimo, British Columbia
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BIOLOGICAL RESULTS OF THE STRAIT OF GEORGIA SPINY DOGFISH (*Squalus Acanthias*) LONGLINE SURVEY OCTOBER 10-22, 2008

by

J.R. King and G.A. McFarlane

Fisheries and Oceans Canada
Science Branch, Pacific Region
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ABSTRACT

King, J.R., and McFarlane, G.A. 2009. Biological results of the Strait of Georgia spiny dogfish (*Squalus Acanthias*) longline survey October 10-22, 2008. Can. Data Rep. Fish. Aquat. Sci. 1220: iii + 27 p.

From October 10 to 22, 2008, a spiny dogfish (*Squalus acanthias*) longline survey was conducted in the Strait of Georgia aboard the *CCGS Neocaligus*. Fishing occurred at ten sites selected in previous surveys to be representative of commercial fishing areas: Active Pass, Porlier Pass, Sturgeon Bank, French Creek, Hornby Island, Cape Lazo, Cape Mudge, Grants Reef, Sinclair Bank and Epson Point. Five depth strata were fished during this survey: 0 to 55 m, 56 to 110m, 111 to 165m, 166 to 220m and deeper than 220m. All captured spiny dogfish were measured for length and sex. Second dorsal spines were removed for age estimation from size selected male dogfish and site specific female dogfish. Maturity condition was collected for all females, for all fish from which spines were collected and from a random subsample of males. Other encountered species were enumerated.

RESUMÉ

King, J.R., and McFarlane, G.A.. 2009. Biological results of the Strait of Georgia spiny dogfish (*Squalus Acanthias*) longline survey October 10-22, 2008. Can. Data Rep. Fish. Aquat. Sci. 1220: iii + 27 p.

Nous avons effectué un relevé de l'aiguillat commun (*Squalus acanthias*) à la palangre du 10 au 22 octobre 2008 dans le détroit de Georgia à partir du NGCC *Neocaligus*. La pêche a été pratiquée à 10 sites choisis lors de relevés précédents comme représentatifs de zones de pêche commerciale : la passe Active, la passe Porlier, le banc Sturgeon, le ruisseau French, l'île Hornby, le cap Lazo, le cap Mudge, le récif Grants, le banc Sinclair et la pointe Epson. Cinq strates de profondeur ont été échantillonnées : 0 à 55 m, 56 à 110 m, 111 à 165 m, 166 à 220 m et les profondeurs de plus de 220 m. Nous avons établi la longueur et le sexe de tous les aiguillats capturés; prélevé, aux fins d'estimation de l'âge, la deuxième épine dorsale de mâles choisis selon la taille et de femelles choisies selon le site, déterminé l'état de maturité de toutes les femelles, de tous les individus dont des épines ont été prélevées et d'un sous-échantillon aléatoire de mâles a été déterminé; et dénombré les autres espèces capturées.

INTRODUCTION

Spiny dogfish (*Squalus acanthias*) were an important component of Canada's Pacific fishery from the late 1800s to the mid 1950s (Ketchen 1986). A resurgence in interest in the fishery led to an increase in catches in the late 1970s, particularly in the Strait of Georgia. Based on tagging studies (McFarlane and King 2002), the Strait of Georgia stock is considered to be discreet. The increase in fishing catches in the late 1970s prompted the initiation of an assessment program. As part of this study, longline surveys were conducted in the Strait of Georgia in 1986 and 1989 (McFarlane et al 2005a) and 2005 (McFarlane et al. 2006) to provide baseline biological, catch and effort data for selected sites. A longline calibration survey was conducted in 2004 to account for catch rate changes that might have occurred in the commercial fishery due to a change from using J-hooks to using circle hooks (McFarlane et al. 2005b). This report provides catch and biological summary data for a fourth survey conducted in the Strait of Georgia from October 10-22, 2008. It is our intention to continue these surveys on a tri-annual basis in order to monitor the status of spiny dogfish in the Strait of Georgia.

METHODS

From October 10 to 22, 2008 the spiny dogfish longline survey was conducted onboard the *CCGS Neocaligus*.

Longline fishing occurred at ten sites throughout the Strait of Georgia (Figure 1) selected to be representative of commercial fishing areas which were surveyed in previous surveys. The sites were located near Active Pass, Cape Lazo, Cape Mudge, Epson Point, French Creek, Grant Reef, Hornby Island, Porlier Pass, Sinclair Bank and Sturgeon Bank (see Appendix 2 for positional data). At each site, four depth strata were fished in random order, however the depth strata were selected to correspond to the depth strata fished in the 2005 survey. The depth strata fished were the following:

1. 0 to 55m,
2. 56 to 110m,
3. 111 to 165m and,
4. 166 to 220m.
5. greater than 220 m

Once the vessel arrived at the pre-selected site the appropriate depth range was located and fishing proceeded along the depth contour.

Each longline set consisted of 2 groundlines (5/16 inch leaded copolym) with an anchored buoyline (3/8 inch polysteel) hooked on at each end. Model 72 snaps (3 cm in width; 13 cm in length), made from 3.2 mm stainless steel wire, were snapped onto the groundline every 2 meters as the gear was set. Attached to the snap, crimped Perlon snap

gangions 30 cm long were fitted with circle hooks. Size #14/0 Mustad circle hooks were used. Each hook was baited with a third of a 6 inch herring.

For each location the groundline was deployed with 300 baited hooks per set. This number is lower than previous surveys which used 500 baited hooks per set (1986 and 1989) or 400 baited hooks per set (2005). To access differences in catch rates, four extra sets were conducted at French Creek with 400 baited hooks per set. These sets were fished four days after (October 22, 2008) the initial four sets were fished (October 18, 2008). Hook number in this survey was reduced due to high catch rates in the previous surveys and to reduce the number of hours required for sampling the catch.

The effective fishing time for each set was recorded as the time from when the first hook was deployed until the main groundline anchor was onboard. In order to minimize bias in catch rates due to differences in effective fishing time, all longline sets were fished for approximately 2 hours. Catch per unit effort (CPUE) for a longline set was calculated as the total number of spiny dogfish caught per thousand hooks.

All fish, other than those lost at the surface, were removed from the hooks, identified to species and counted. All dogfish lost at surface were noted and included in the total catch numbers. All spiny dogfish brought on board were retained for sampling; other species were identified and immediately released.

Length and sex were recorded from all captured spiny dogfish. Length was measured (mm) as the total length of the fish; from the tip of the snout to the tip of the upper lobe of the caudal fin when it was directed downward in a straight line with the body. Sex was determined externally for both male and female dogfish. Maturity was determined for all female dogfish, for all dogfish for which spines were collected for ageing and for a random subsample of male dogfish. Maturity was determined internally for females, externally for males. Maturity stages are described in Appendix 2. Briefly, the female maturity has two stages, one describing the condition of the ovary and a second describing the condition of the uteri. Males were grouped into 3 categories; immature, maturing and mature. Females were grouped into 16 categories with 4 for immature fish, 6 for maturing and 6 for mature fish. When maturity was determined for a female, if uterine pups were present, the number were recorded.

Second dorsal spines were removed for age determination (Beamish and McFarlane 1985) from a random subsample of fish at each location and stored individually in pre-numbered envelopes. Spines were frozen onboard, to be later thawed, air dried and stored.

RESULTS

From October 10-21, 2008, 12,299 hooks were set over 41 sets at 10 sites; and 1600 additional hooks were set at French Creek on October 22, 2008 for effort comparison (Table 1). At each site, 4 depth strata were fished except for Cape Lazo were all 5 depth strata were fished (Appendix 2). The end time of hook retrieval was not recorded for the first 21 sets, so effective fishing time could not be calculated (Appendix 2). However, the start time of hook retrieval was recorded, and was typically 2 hours after the end time of hook deployment for all sets (Appendix 2). Generally, the time required to retrieve all hooks was about 35 minutes (Appendix 2); so the effective fishing time for these first 21 sets should be comparable to the remaining sets. The mean effective time for the remaining sets was 171 minutes (Table 1). A total of 6,366 spiny dogfish were captured (Table 2). Longnose skate (*Raja rhina*), Ratfish (*Hydrolagus colliei*), Quillback rockfish (*Sebastes maliger*), Yelloweye rockfish (*S. ruberrimus*) and were the most frequent bycatch encountered (Table 2). Biological data were recorded for spiny dogfish captured during the effort comparison at French Creek (Effort 2), however those results are not reported in the summaries below.

CATCH PER UNIT EFFORT

For the three depth strata common to all locations (2, 3 and 4) the mean CPUE for all spiny dogfish was 447 fish/1000 hooks (Table 1). CPUE by site ranged from 354 (Hornby Island) to 554 (Cape Lazo) fish/1000 hooks. The CPUE for male spiny dogfish was typically higher than for female spiny dogfish (Table 1). Sites with the highest dogfish CPUE were Cape Lazo, Sturgeon Bank and Grant Reef. Hornby Island, Epson Point and French Creek had the lowest CPUE. The CPUE for French Creek Effort 1 (300 hooks per set) was higher than for Effort 2 (400 hooks per set) (Table 1). CPUE varied by depth with increasing CPUE by depth (Table 3).

LENGTH FREQUENCY

Length and sex was recorded for 5,728 dogfish (93 fish were lost at surface; 5 fish were missed for length measurements). Detailed spiny dogfish length frequency catch data for sex by fishing site and sex by depth strata is presented in Tables 4 and 5 and Figures 2 and 3.

A total of 1969 females and 3759 males were measured (Table 4). Male spiny dogfish ranged in size from 487-946 mm with a mean length of 767 cm (Table 5). Female spiny dogfish ranged in size from 450-1120 mm with a mean length of 815 mm (Table 5). Mean female and male dogfish size decreased with increasing depth. The mean total length for females was greater than males in all depth stratum, except the deepest (Table 5). The smallest spiny dogfish was a female (450 mm) caught in depth stratum 4; the largest was also a female (1120 mm) caught in depth stratum 2 (Table 5).

By depth and area, the size distribution for female spiny dogfish was more uniform across the size range than that of male spiny dogfish, which often had a definitive mode (Figures 2 and 3).

SEX DISTRIBUTION BY DEPTH STRATA AND SITE

Depth strata

For all sites combined in the Strait of Georgia, there was a larger proportion of male spiny dogfish caught in each depth strata (Figure 4). Female dogfish were present in increasing proportion by depth (Figure 4).

Site

Seven of the ten sites had a larger proportion of male spiny dogfish ranging from 30% to 95% of the catch. At the remaining three sites, Epson Point, French Creek and Sinclair Bank, female spiny dogfish proportion ranged from 52% to 70% of the catch (Figure 5).

MATURITY

Maturity condition was assessed for selected male and for female spiny dogfish (full description of maturity condition in Appendix 1).

Male spiny dogfish maturity

Of all male spiny dogfish sampled, 79.9% were mature; 6.22% maturing; and 13.88% immature (Table 6). In all depth strata mature male dogfish were the most abundant. Varying by depth mature male spiny dogfish ranged from 66.67-92.45% of male dogfish catch, maturing male dogfish ranged from0-25.49 % and immature male dogfish ranged from 0-7.84% of sampled male catch (Table 7).

Female spiny dogfish maturity

Of the female dogfish sampled, 72% were immature; 7.23 % were maturing; and 20.69 % were mature (Table 6). Immature female dogfish were the most abundant in depth strata 3-5 (Table 7). Depth strata 1 and 2 were dominated by mature female dogfish, although only 4 females were captured in depth stratum 1 (Table 7). Varying by depth, immature female spiny dogfish ranged from 0-91.17% of female dogfish sampled, maturing female dogfish ranged from 0-12.63% and mature female dogfish ranged from 4.19-100% of sampled female catch (Table 7).

Uterine pups

A total of 363 female dogfish (17% of all females examined; 89% of mature females) had uterine pups (Table 8). The largest number of fish with uterine pups was observed at French Creek (n=159 fish), followed by Epson Point (n=87 fish) and Porlier Pass (n=68 fish; Table 8). Approximately 58% of the female dogfish with uterine pups had litter sizes between 4 and 6 (Table 9). Generally, litter size increased with length (Table 9).

DISCUSSION

This is the fourth longline survey conducted in the Strait of Georgia designed to monitor the status, and collect biological samples of spiny dogfish. The information from these surveys will provide the basis for examining current and future spiny dogfish dynamics and abundance trends in the Strait of Georgia.

ACKNOWLEDGMENTS

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Table 1. Summary by fishing area of number of sets, mean effective fishing time, number of hooks deployed, number of measured spiny dogfish, catch per unit effort (fish per 1000 hooks; CPUE) for all depth strata fished at a location and for three core depth strata that were fished at every location (56-110 m; 111-165 m; 166-220 m) from the October 10 to 22, 2008 Strait of Georgia spiny dogfish longline survey. French Creek was fished twice: 1-October 18, 2008 with 300 baited hooks per set (Effort 1); 2-October 22, 2008 with 400 baited hooks per set (Effort 2).

					CPUE					
					All depth strata			Three depth strata		
Location	Number of sets	Mean effective fishing time	Number of hooks	Number of spiny dogfish	Male	Female	Total	Male	Female	Total
Active Pass	4	162	1200	599	326	163	499	311	124	450
Cape Lazo	5	--	1500	740	407	80	793	470	78	554
Cape Mudge	4	--	1199	591	363	120	493	362	91	464
Epson Point	4	172	1200	542	153	293	452	134	220	360
French Creek (Effort 1)	4	176	1200	554	215	237	462	130	258	397
Grant Reef	4	--	1200	598	279	209	498	277	194	479
Hornby Island	4	--	1200	330	245	24	275	317	30	354
Porlier Pass	4	171	1200	552	351	103	460	292	107	404
Sinclair Bank	4	--	1200	643	161	370	536	144	323	473
Sturgeon Bank	4	169	1200	677	531	27	564	506	19	530
		Total	12299	5826		Overall	474		Overall	447
French Creek (Effort 2)	4	174	1600	540	222	183	415	94	114	215

Table 2. Number of fish caught by species during the October 2008 spiny dogfish longline survey. Recorded species include: Spiny dogfish (*Squalus acanthias*), Sixgill shark (*Hexanchus griseus*), Brown cat shark (*Apristurus brunneus*), Big skate (*Raja. binoculata*), Longnose skate (*R. rhina*), Ratfish (*Hydrolagus colliei*), Pacific cod (*Gadus macrocephelus)*, Pacific tomcod (*Microgadus proximus*), Copper rockfish (*Sebastes caurinus),* Quillback rockfish (*S. maliger),* Greenstripe rockfish (*S. elongates),* Yelloweye rockfish (*S. ruberrimus*), Sablefish (*Anoplopoma fimbria*), Lingcod (*Ophiodon elongates*), Red Irish lord (*Hemilepidotus hemilepidotus*), Flathead sole (*Hippoglossoides elassodon*), and Pacific halibut (*Hippoglossus stenolepis*). A total of 6,366 spiny dogfish were hooked; 106 were lost at surface; 6,259 were sampled.

Set	Spiny dogfish	Sixgill shark	Brown cat shark	Big skate	Longnose skate	Ratfish	Pacific cod	Pacific tomcod	Copper rockfish	Greenstripe rockfish	Quillback rockfish	Yelloweye rockfish	Sablefish	Lingcod	Red Irish lord	Flathead sole	Pacific Halibut
1	116	–	–	–	8	–	–	–	–	–	–	–	–	–	–	–	–
2	172	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3	31	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–
4	11	–	–	–	2	–	–	–	1	–	–	–	–	1	–	–	–
5	217	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–	–
6	184	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
7	24	–	–	1	1	2	–	–	–	–	–	–	–	–	–	–	1
8	109	–	–	–	–	2	–	–	1	–	–	1	1	–	–	–	–
9	206	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10	55	–	–	–	1	3	–	–	1	–	2	–	–	–	1	2	–
11	185	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
12	178	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13	173	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
14	86	–	–	–	–	–	–	–	–	–	2	5	–	–	–	–	–
15	173	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
16	167	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
17	172	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
18	176	–	–	–	1	–	–	–	–	–	4	–	–	–	–	–	–
19	220	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
20	217	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
21	30	–	–	–	–	–	–	–	–	–	1	5	–	–	–	–	–
22	218	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
23	228	–	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–
24	2	–	–	–	–	–	–	–	1	1	5	–	–	–	–	–	–

Table 2 continued. Number of fish caught by species during the October 2008 spiny dogfish longline survey. Recorded species include: Spiny dogfish (*Squalus acanthias*), Sixgill shark (*Hexanchus griseus*), Brown cat shark (*Apristurus brunneus*), Big skate (*Raja. binoculata*), Longnose skate (*R. rhina*), Ratfish (*Hydrolagus colliei*), Pacific cod (*Gadus macrocephelus)*, Pacific tomcod (*Microgadus proximus*), Copper rockfish (*Sebastes caurinus),* Quillback rockfish (*S. maliger),* Greenstripe rockfish (*S. elongates),* Yelloweye rockfish (*S. ruberrimus*), Sablefish (*Anoplopoma fimbria*), Lingcod (*Ophiodon elongates*), Red Irish lord (*Hemilepidotus hemilepidotus*), Flathead sole (*Hippoglossoides elassodon*), and Pacific halibut (*Hippoglossus stenolepis*). A total of 6,366 spiny dogfish were hooked; 106 were lost at surface; 6,259 were sampled.

Set	Spiny dogfish	Sixgill shark	Brown cat shark	Big skate	Longnose skate	Ratfish	Pacific cod	Pacific tomcod	Copper rockfish	Greenstripe rockfish	Quillback rockfish	Yelloweye rockfish	Sablefish	Lingcod	Red Irish lord	Flathead sole	Pacific Halibut
25	94	–	–	–	–	1	1	–	–	–	–	2	–	–	–	–	–
26	144	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–
27	197	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
28	174	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–
29	39	–	–	–	1	–	–	–	–	–	2	5	–	–	–	–	–
30	194	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
31	53	–	–	–	–	–	–	–	–	1	1	–	–	1	–	–	1
32	117	–	–	–	–	–	–	–	–	1	1	1	–	1	–	–	–
33	188	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
34	188	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
35	210	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
36	7	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
37	194	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
38	200	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
39	201	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
40	192	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
41	84	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
42	74	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	–
43	282	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
44	143	–	–	–	1	3	1	–	–	–	–	–	–	–	–	–	–
45	41	–	–	–	1	–	–	–	–	–	–	7	–	–	–	–	–
Total	6366	2	1	1	18	11	2	1	4	3	25	32	1	4	1	2	2

Table 4. Spiny dogfish total length frequency data by 50 mm length intervals sex. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

Length interval	Number of males	Number of females
450-499	2	1
500-549	20	24
550-599	121	146
600-649	226	278
650-699	477	326
700-749	917	286
750-799	1235	221
800-849	568	187
850-899	159	202
900-949	34	169
950-999	0	77
1000-1049	0	36
1050-1099	0	15
1100-1149	0	1
Total	3759	1969

Table 3. Summary of CPUE (fish per 1000 hooks), mean effective fishing time (minutes) and number of spiny dogfish captured by depth stratum. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

					Number of spiny dogfish				CPUE		
Depth stratum	Depth range	Number of sets	Mean effective fishing time	Number of hooks	Males	Females	Lost	Total	Males	Females	Total
1	0-55	2	120	600	31	4	0	35	52	7	58
2	56-110	10	119	3000	193	395	13	601	64	132	200
3	111-165	10	121	3000	1049	412	27	1488	350	137	496
4	166-220	10	121	3000	1205	695	31	1931	402	232	644
5	>221	9	122	2700	1079	670	22	1771	400	248	656

Table 5. Summary (minimum, maximum and mean) of total length (mm) data for spiny dogfish captured by depth stratum. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

	Male spiny dogfish			Female spiny dogfish			All spiny dogfish		
Depth stratum	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
1	717	946	829	904	982	946	717	982	842
2	597	940	780	571	1120	895	571	1120	818
3	530	922	758	518	1069	783	518	1069	765
4	487	945	742	450	1082	743	450	1082	743
5	520	932	726	512	1044	710	512	1044	720

Table 6. Number of male and female spiny dogfish observed for each maturity stage. Proportions are percentages of totals by sex. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison. Detailed description of maturity codes are in Appendix 1.

Sex	Maturity state	Maturity code	Number of fish	Proportion of sex total
Female	Immature	10	1184	60.29
		50	67	3.41
		51	141	7.18
		53	22	1.12
	Total immature		1414	72
	Maturing	55	4	0.2
		56	72	3.67
		70	8	0.41
		71	25	1.27
		73	21	1.07
		75	12	0.61
	Total maturing		142	7.23
	Mature	77	250	12.74
		78	2	0.1
		79	12	0.61
		95	6	0.31
		97	11	0.56
		98	104	5.3
		99	21	1.07
	Total mature		406	20.69
Male	Immature	10	29	13.88
	Maturing	30	13	6.22
	Mature	90	167	79.9

Table 7. Number and proportion (percentage of depth stratum total) of female and male spiny dogfish by maturity stage in each depth stratum. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

		Immature		Maturing		Mature	
Sex	Depth stratum	Number	Proportion	Number	Proportion	Number	Proportion
Males							
	1	0	0	0	0	0	0
	2	2	3.77	2	3.77	49	92.45
	3	2	3.85	3	5.77	47	90.38
	4	13	25.49	4	7.84	34	66.67
	5	12	22.64	4	7.55	37	69.81
Females							
	1	0	0	0	0	4	100
	2	20	10.53	24	12.63	146	76.84
	3	266	65.2	23	5.64	119	29.17
	4	519	75	64	9.25	109	15.75
	5	609	91.17	31	4.64	28	4.19

Table 8: The number of female spiny dogfish observed with pups by location. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

Location	Number of fish
Active Pass	13
Cape Lazo	2
Cape Mudge	0
Epson Point	87
French Creek	159
Grant Reef	10
Hornby Island	3
Porlier Pass	68
Sinclair Bank	13
Sturgeon Bank	8

Table 9. Number, proportion (percentage of total females with pups) and total length (mm) data of female spiny dogfish sampled with uterine pups by litter size. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

Litter size	Number of fish	Proportion	Minimum	Maximum	Mean
1	8	2.2	834	907	871
2	17	4.68	762	940	875
3	38	10.47	800	1022	888
4	64	17.63	760	992	902
5	82	22.59	809	1063	916
6	66	18.18	816	1007	931
7	32	8.82	892	1010	954
8	23	6.34	891	1071	991
9	13	3.58	928	1034	983
10	11	3.03	987	1080	1045
11	7	1.93	927	1082	1036
12	1	0.28	--	--	1079
13	0	0	--	--	--
14	0	0	--	--	--
15	1	0.28	--	--	1120

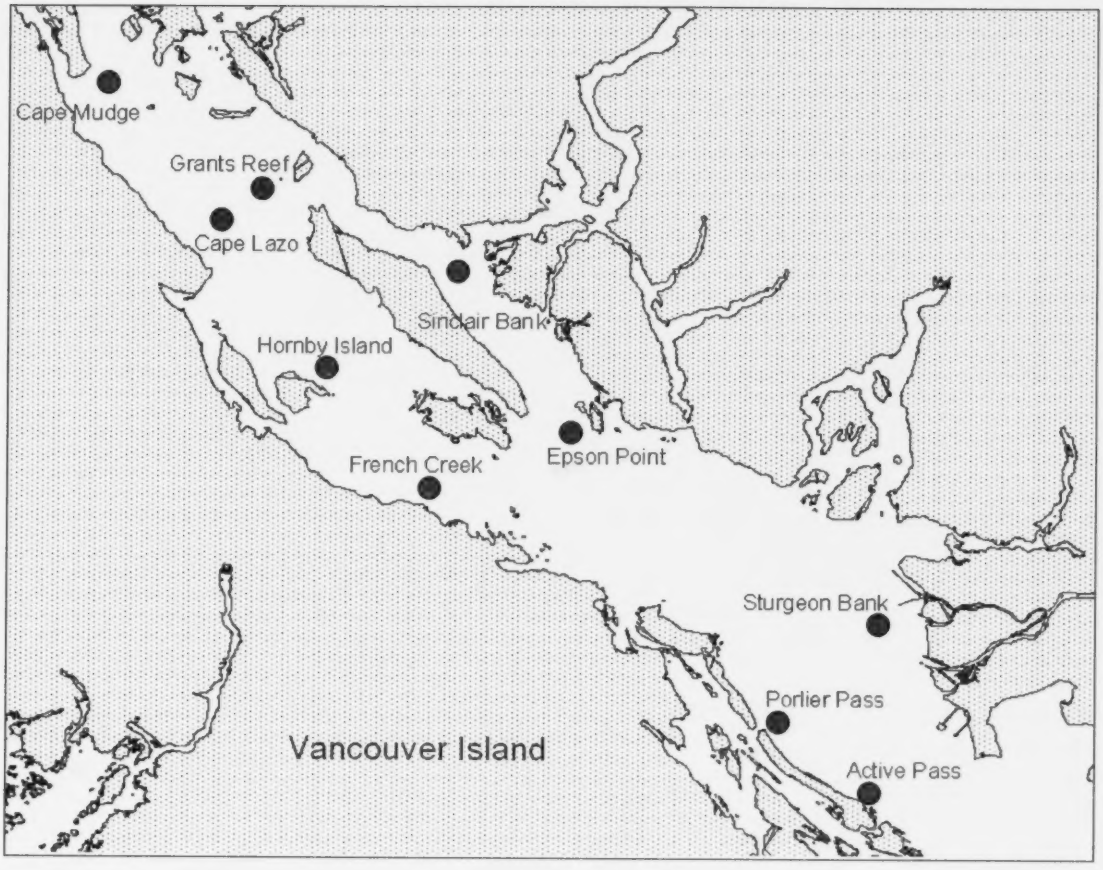

Figure 1. Set locations from the Strait of Georgia spiny dogfish longline survey conducted October 10-22, 2008. For detailed positional information see Appendix 2.

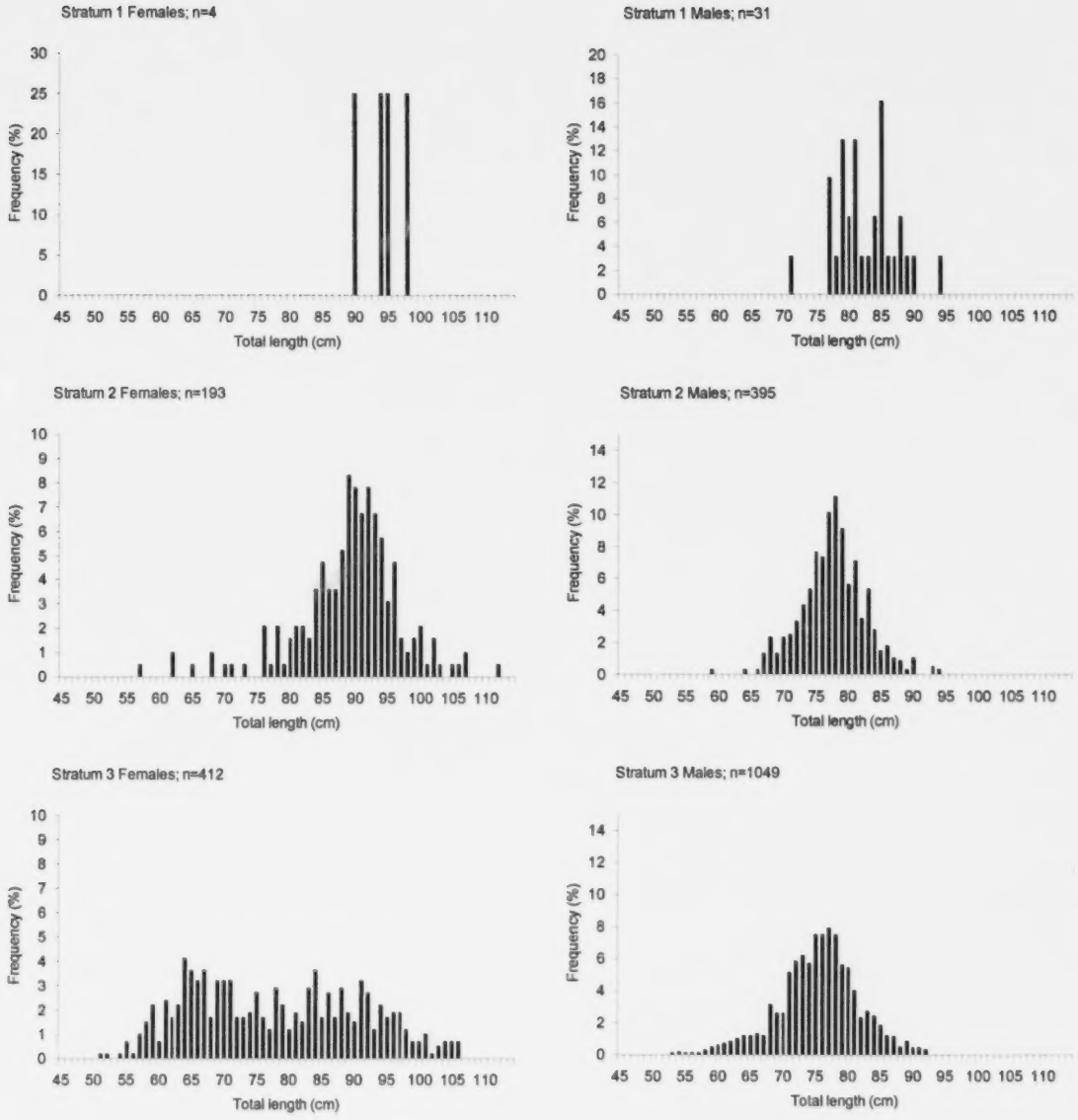

Figure 2. Spiny dogfish length frequency by depth stratum (2: 56 to 110m, 3: 111 to 165m, 4: 166 to 220m and 5: deeper than 220m). Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

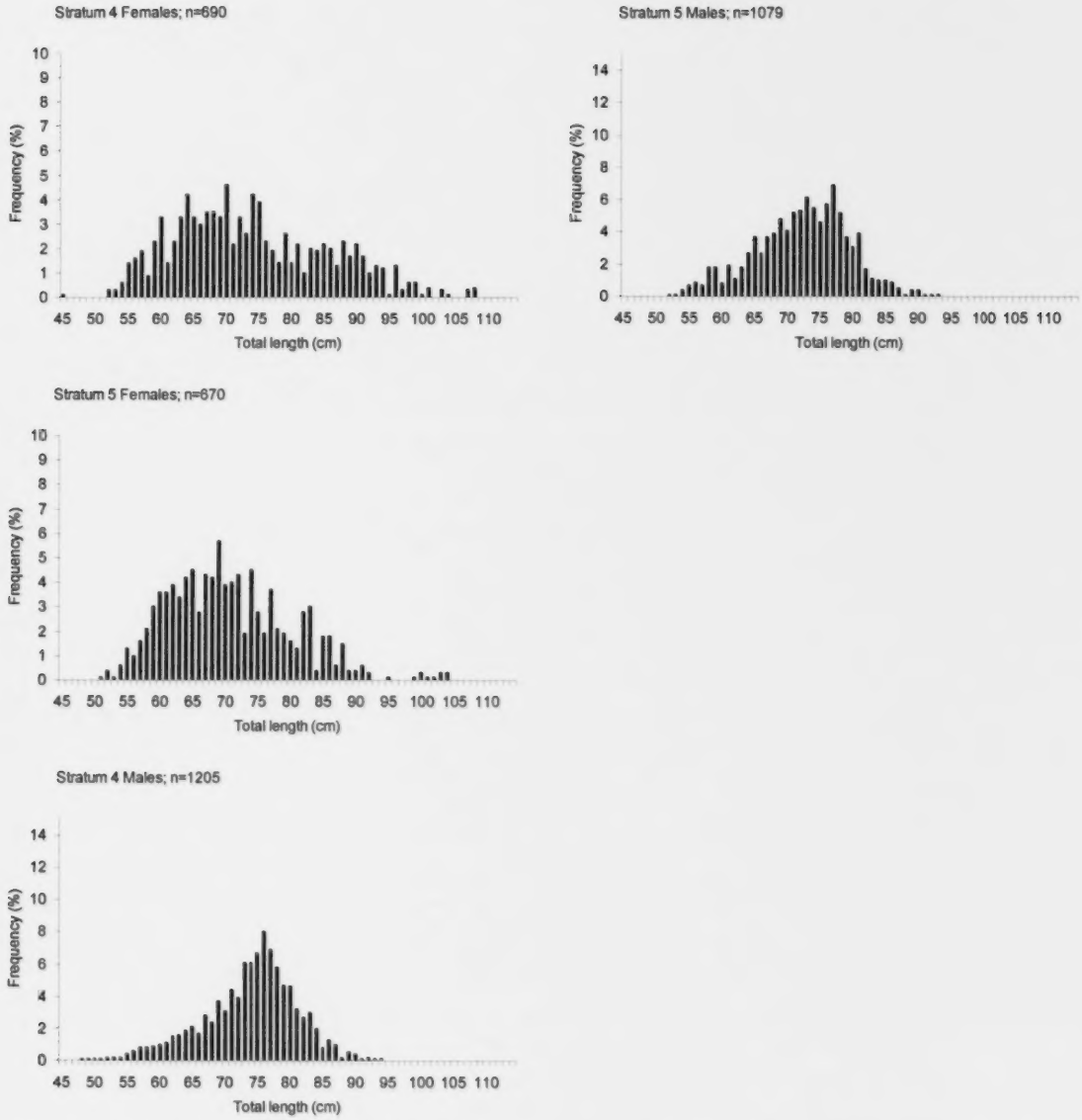

Figure 2 continued. Spiny dogfish length frequency by depth stratum (2: 56 to 110m, 3: 111 to 165m, 4: 166 to 220m and 5: deeper than 220m). Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

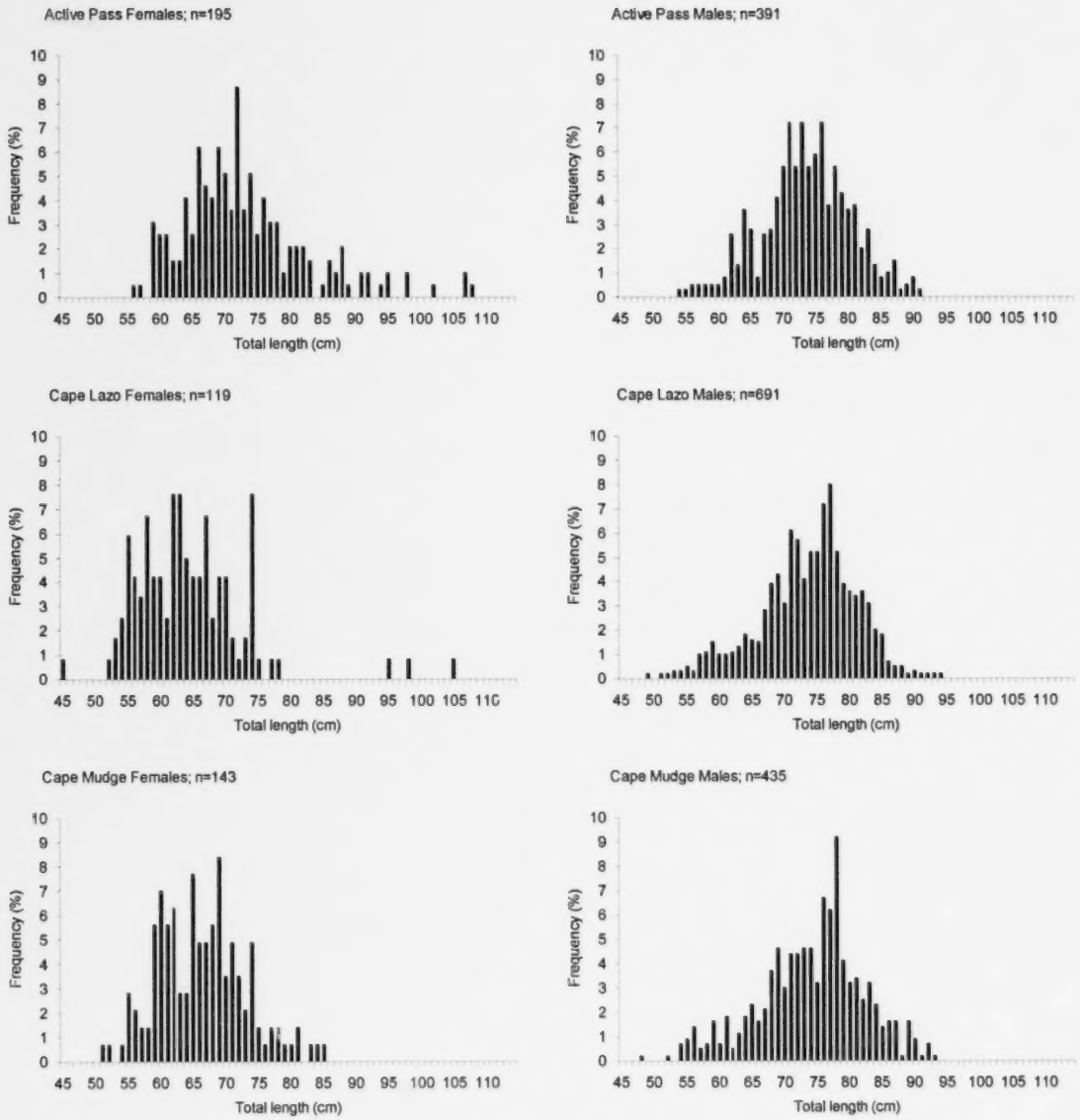
Active Pass Females; n=195
Active Pass Males; n=391
Cape Lazo Females; n=119
Cape Lazo Males; n=691
Cape Mudge Females; n=143
Cape Mudge Males; n=435
Frequency (%)
Total length (cm)
0 1 2 3 4 5 6 7 8 9 10
45 50 55 60 65 70 75 80 85 90 95 100 105 110

Figure 3. Spiny dogfish length frequency by location. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

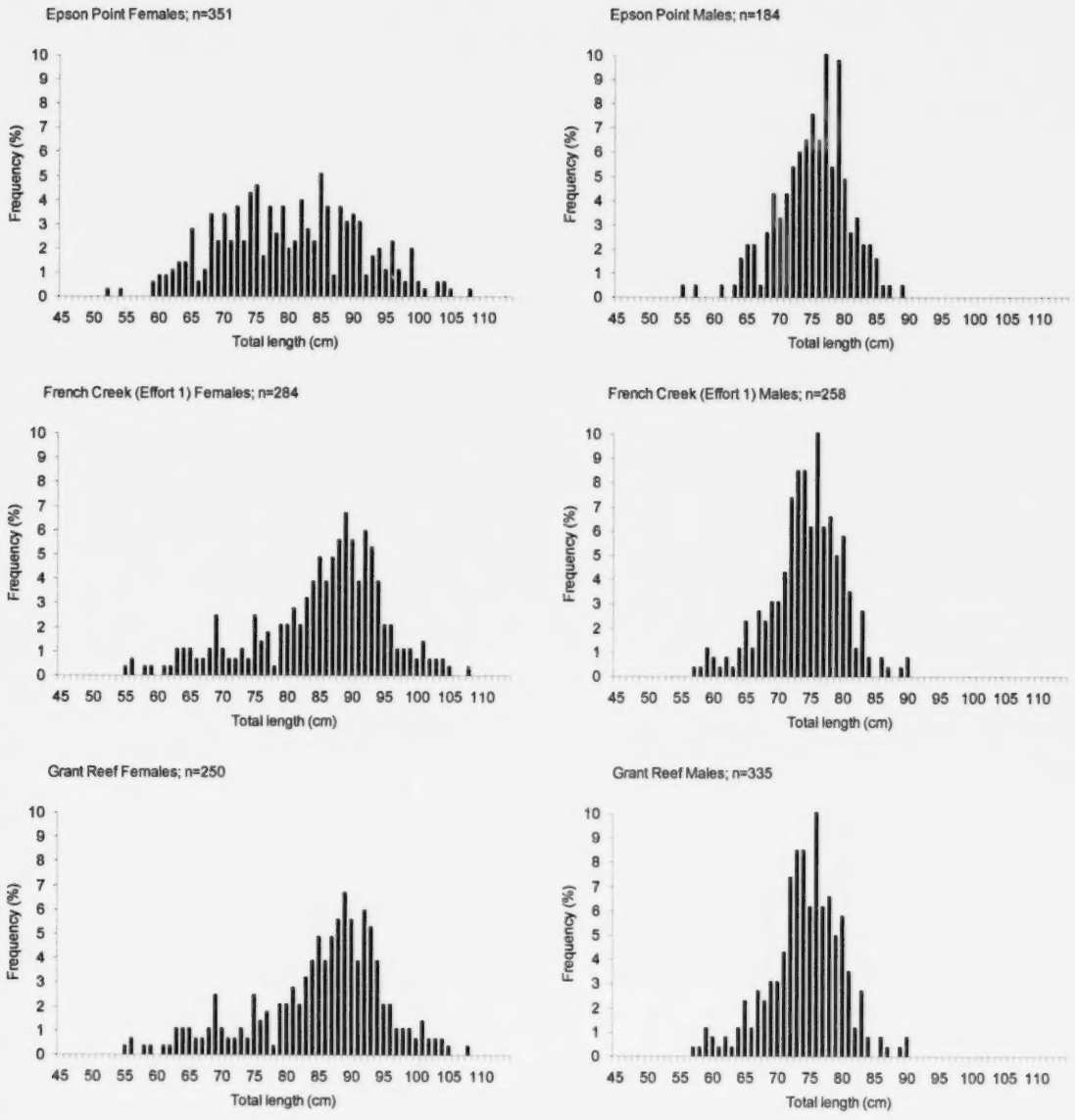
Epson Point Females; n=351
Epson Point Males; n=184
French Creek (Effort 1) Females; n=284
French Creek (Effort 1) Males; n=258
Grant Reef Females; n=250
Grant Reef Males; n=335
Frequency (%)
Total length (cm)
0 1 2 3 4 5 6 7 8 9 10
45 50 55 60 65 70 75 80 85 90 95 100 105 110

Figure 3 continued. Spiny dogfish length frequency by location. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

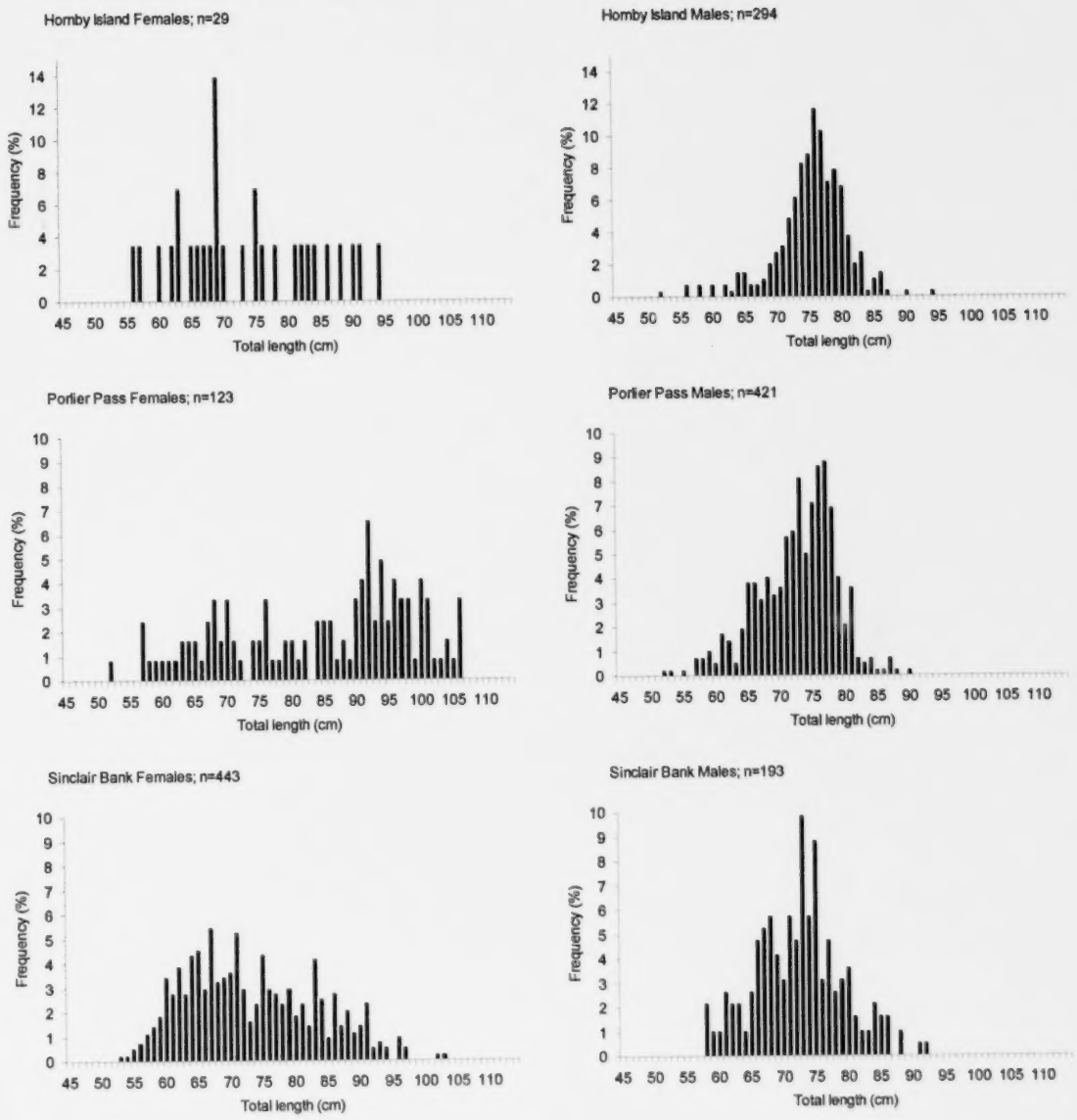
Hornby Island Females; n=29
Hornby Island Males; n=294
Porlier Pass Females; n=123
Porlier Pass Males; n=421
Sinclair Bank Females; n=443
Sinclair Bank Males; n=193
Frequency (%)
Total length (cm)
45 50 55 60 65 70 75 80 85 90 95 100 105 110

Figure 3 continued. Spiny dogfish length frequency by location. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

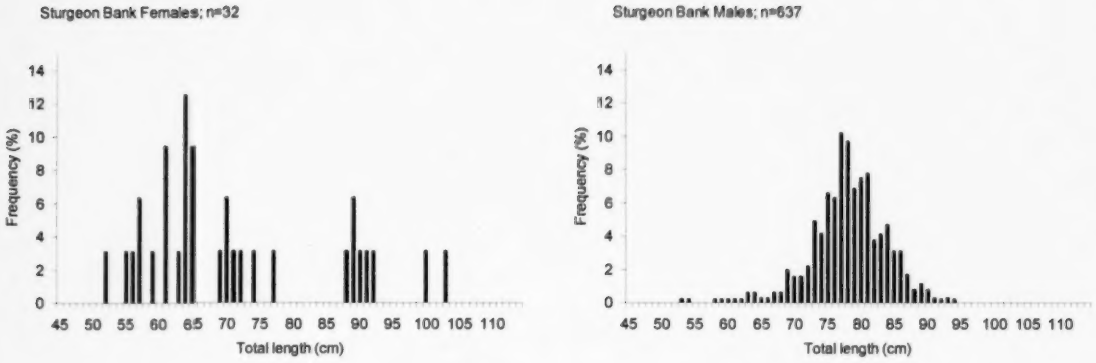

Figure 3 continued. Spiny dogfish length frequency by location. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

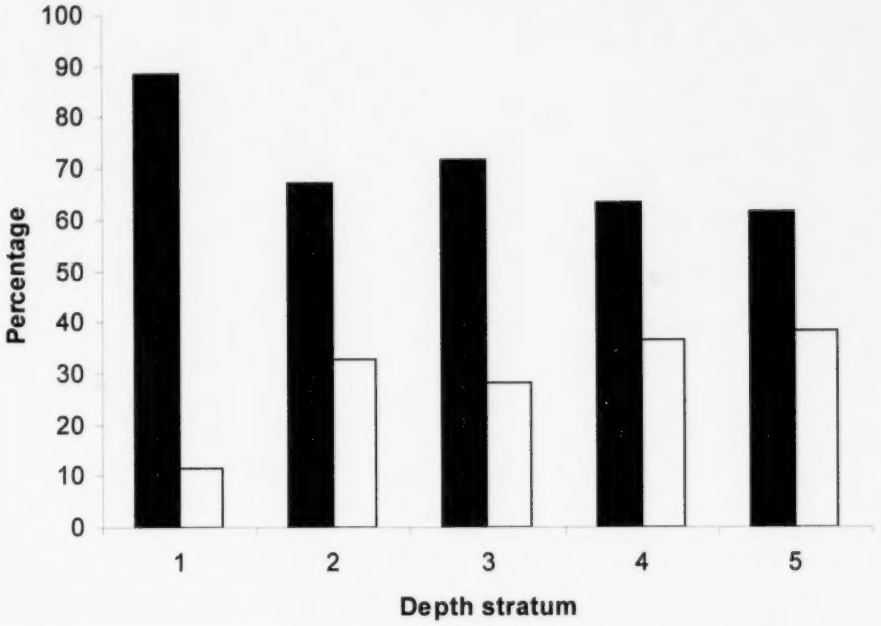

Figure 4. Spiny dogfish sex ratio by depth stratum (1: 0 to 55m, 2: 56 to 110m, 3: 111 to 165m, 4: 166 to 220m and 5: deeper than 220m). Black bars are males; white bars are females. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

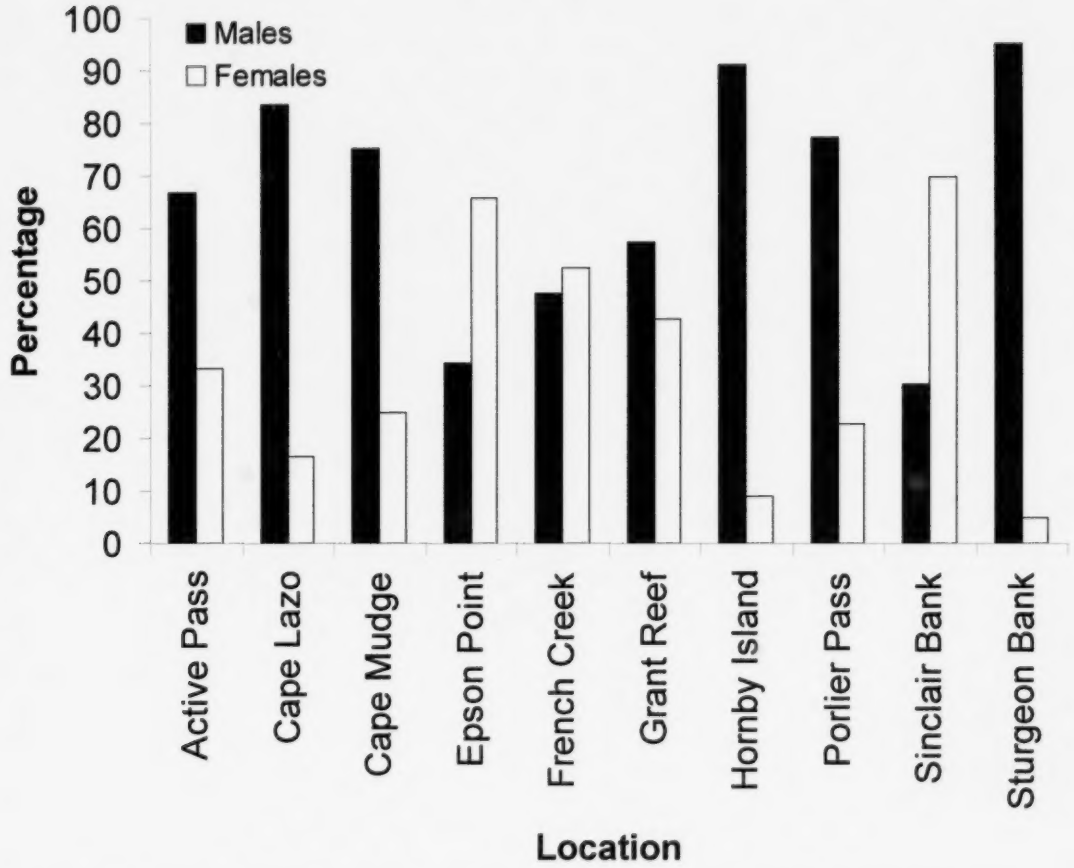

Figure 5. Spiny dogfish sex ratio by location. Data do not include depth strata repeated at French Creek (October 22, 2008) conducted for effort comparison.

Appendix 1. Description of maturity codes used for spiny dogfish.

Male		
Maturity Code	Description	Maturity Stage
10	Claspers do not extend past tips of anal fins; testes flat creamy.	Immature
30	Claspers extend past tips of anal fins; not stiff; testes, even creamy coulour, not brown	Maturing
90	Claspers extend past tips of anal fins; stiff; testes, cramy-brown, bloodshot, very firm	Mature

Female			
Maturity Code	Ovaries	Uterii	Maturity Stage
10	Ova small, 0-5 mm diameter white firm ovary<1/4 length of body cavity.	Thin no thickening	Immature
50	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	Thin no thickening	Immature
51	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	Thin, <5mm thickened section, <1/4 length of body cavity	Immature
53	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	About 5mm thickened section < 1/4 length of body cavity	Immature
55	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	Thickened section at least 10mm or wider, flaccid; >1/3 length of body cavity	Maturing
56	Ova 5-10mm, white firm, ovary flaccid, flocculent external surface.	Encapsulated uterine eggs (candles)	Maturing
70	Ova yellow firm <30mm	Thin no thickening diameter	Maturing
71	Ova yellow firm <30mm	Thin, <5mm thickened section, <1/4 length of body cavity	Maturing
73	Ova yellow firm <30mm	About 5mm thickened section < 1/4 length of body cavity	Maturing
75	Ova yellow firm <30mm	Thickened section at least 10mm or wider, flaccid 1/3 length of body cavity	Maturing
77	Ova yellow firm <30mm	Yolk sac pups	Mature
78	Ova yellow firm <30mm	Term pups (no yolk sac)	Mature
79	Ova yellow firm <30mm	Flaccid	Mature
95	Ova white firm <10mm in diameter and yellow firm > 30mmin diameter; ovary flacid 1/3 length of body cavity	Thickened section at least 10mm or wider, flaccid; >1/3 length of body cavity	Mature
97	Ova white firm <10mm in diameter and yellow firm > 30mmin diameter; ovary flacid 1/3 length of body cavity	Yolk sac pups	Mature
99	Ova white firm <10mm in diameter and yellow firm > 30mmin diameter; ovary flacid 1/3 length of body cavity	Flaccid and empty	Mature

Appendix 2. Bridge log from the October 10-22, 2008 spiny dogfish longline survey aboard the *CCGS Neocaligus*. Effective fishing time in minutes; all depths in meters; latitude and longitude in decimal degrees; distance in nautical miles; vessel speed in knots; direction in degrees true.

Date	Location	Set number	Depth stratum	Number of hooks	Start latitude	Start longitude	End latitude	End longitude	Start time	End time	Effective fishing time	Direction	Distance traveled	Vessel speed	Start depth	End depth
10-Oct-08	Hornby Island	1	3	300	49.5439	124.6069	49.5352	124.5818	8:18	--	--	123	1.1	3.5	126	153
10-Oct-08	Hornby Island	2	4	300	49.5578	124.5847	49.5657	124.5957	9:21	--	--	311	0.6	2.5	177	--
10-Oct-08	Hornby Island	3	2	300	49.541	124.6193	49.5464	124.6306	13:30	--	--	311	0.55	2.5	77	97
10-Oct-08	Hornby Island	4	1	300	49.5413	124.6233	49.5447	124.6366	14:30	--	--	293	--	2.7	50	45
10-Nov-08	Cape Lazo	5	5	300	49.7908	124.845	49.7818	124.2515	8:39	--	--	144	--	3	240	235
10-Nov-08	Cape Lazo	6	4	300	49.7882	124.8556	49.7948	124.8659	9:38	--	--	318	--	3	181	181
10-Nov-08	Cape Lazo	7	1	300	49.75	124.9252	49.76	124.9259	13:30	--	--	--	0.63	2.7	30	47
10-Nov-08	Cape Lazo	8	2	300	49.7766	124.9132	49.7738	124.899	8:40	--	--	110	0.6	2.7	68	70
12-Oct-08	Cape Lazo	9	3	300	49.7905	124.8739	49.7822	124.8654	9:32	--	--	147	--	2.7	157	156
12-Oct-08	Cape Mudge	10	2	300	49.9763	125.1157	49.9767	125.1195	13:55	--	--	275	0.7	2.7	88	66
13-Oct-08	Cape Mudge	11	4	300	49.9885	125.0965	49.9789	125.092	8:45	--	--	160	0.6	3	183	207
13-Oct-08	Cape Mudge	12	3	300	49.9956	125.1092	49.9886	125.103	9:46	--	--	131	0.5	2.8	157	141
13-Oct-08	Cape Mudge	13	5	299	49.9943	125.0911	50	125.2624	13:07	--	--	245	0.46	3	258	267
14-Oct-08	Grant Reef	14	2	300	49.8621	124.7737	49.8585	124.9105	8:21	--	--	125	0.56	2.7	80	98
14-Oct-08	Grant Reef	15	3	300	49.8404	124.7378	49.8317	124.7315	9:08	--	--	160	--	2.7	161	161
14-Oct-08	Grant Reef	16	5	300	49.8162	124.7667	49.8077	124.7564	12:54	--	--	140	0.65	2.7	222	229
14-Oct-08	Grant Reef	17	4	300	49.8238	124.742	49.814	124.7488	13:48	--	--	205	0.64	2.7	183	217
15-Oct-08	Sinclair Bank	18	3	300	49.7106	124.2918	49.7208	124.2987	7:17	--	--	333	--	2.7	119	141
15-Oct-08	Sinclair Bank	19	4	300	49.7126	124.3048	49.7223	124.3103	8:05	--	--	340	--	--	190	188
15-Oct-08	Sinclair Bank	20	5	300	49.7192	124.3115	49.7078	124.3079	11:14	--	--	--	0.7	2.7	238	235
15-Oct-08	Sinclair Bank	21	2	300	49.6934	124.2789	49.7027	124.2827	12:08	--	--	349	0.6	2.7	80	78
17-Oct-08	Epsom Point	22	5	300	49.475	124.0518	49.4681	124.042	8:58	11:00	184	130	--	2.7	247	255
17-Oct-08	Epsom Point	23	4	300	49.4735	124.0419	49.4671	124.0294	10:08	12:15	184	124	--	2	182	186
17-Oct-08	Epsom Point	24	2	300	49.4928	124.042	49.5064	124.0525	14:14	16:12	156	156	--	2.9	88	87
17-Oct-08	Epsom Point	25	3	300	49.4944	124.0558	49.5073	124.064	15:03	17:02	165	345	--	--	154	153
18-Oct-08	French Creek	26	2	300	49.3569	124.3283	49.3506	124.3121	7:56	9:57	172	--	--	--	68	75
18-Oct-08	French Creek	27	5	300	49.3901	124.3506	49.3841	124.3361	8:50	11:01	179	--	--	--	250	231
18-Oct-08	French Creek	28	4	300	49.3759	124.3317	49.3689	124.3158	12:52	14:53	173	120	--	2.8	184	175
18-Oct-08	French Creek	29	3	300	49.3743	124.34	49.3677	124.3268	13:57	15:55	178	120	--	2.8	135	133

Appendix 2 continued. Bridge log from the October 10-22, 2008 spiny dogfish longline survey aboard the *CCGS Neocaligus*. Effective fishing time in minutes; all depths in meters; latitude and longitude in decimal degrees; distance in nautical miles; vessel speed in knots; direction in degrees true.

Date	Location	Set number	Depth stratum	Number of hooks	Start latitude	Start longitude	End latitude	End longitude	Start time	End time	Effective fishing time	Direction	Distance traveled	Vessel speed	Start depth	End depth
19-Oct-08	Porlier Pass	30	4	300	49.0218	123.5308	49.0146	123.5202	8:36	10:35	171	132	–	2.1	188	190
19-Oct-08	Porlier Pass	31	2	300	48.9888	123.5276	48.9973	123.5387	9:40	11:37	160	315	–	2.4	90	56
19-Oct-08	Porlier Pass	32	3	300	49.0929	123.6216	49.0844	123.6185	13:17	15:20	175	161	–	2.6	144	122
19-Oct-08	Porlier Pass	33	5	300	49.081	123.5787	49.0758	123.5682	14:20	16:24	179	128	–	2.5	227	256
20-Oct-08	Active Pass	34	3	300	48.9293	123.3879	48.9356	123.401	8:05	10:03	165	308	–	2.5	162	137
20-Oct-08	Active Pass	35	4	300	48.9212	123.3286	48.9287	123.3365	9:29	11:26	163	–	–	–	190	191
20-Oct-08	Active Pass	36	2	300	48.9313	123.4048	48.9359	123.4118	13:00	14:57	156	308	–	2.3	87	95
20-Oct-08	Active Pass	37	5	300	48.9885	123.4081	48.9851	123.3977	14:02	16:00	162	119	–	2.2	275	268
21-Oct-08	Sturgeon Bank	38	5	300	49.1827	123.3821	49.1911	123.3807	8:40	10:39	171	10	–	2	247	251
21-Oct-08	Sturgeon Bank	39	3	300	49.1765	123.329	49.1843	123.3274	9:37	11:47	180	10	–	2.2	154	154
21-Oct-08	Sturgeon Bank	40	4	300	49.1882	123.3447	49.1946	123.3417	13:19	15:18	156	10	–	2.2	188	187
21-Oct-08	Sturgeon Bank	41	2	300	49.1898	123.3047	49.1822	123.3039	14:11	16:10	170	180	–	2.3	97	89
22-Oct-08	French Creek	42	2	400	49.35	124.311	49.3554	124.3242	8:11	10:09	160	305	–	1.8	72	68
22-Oct-08	French Creek	43	5	400	49.3851	124.3384	49.3911	124.3526	9:23	11:20	183	305	–	2.1	233	251
22-Oct-08	French Creek	44	4	400	49.3693	124.316	49.3761	124.333	13:11	15:09	180	–	–	–	183	177
22-Oct-08	French Creek	45	3	400	49.369	124.3266	49.3747	124.3432	14:21	16:12	173	–	–	2.5	139	124